

# IMAGE PROCESSING SYSTEM AND IMAGE PROCESSING METHOD

## Background of the Invention

### 1. Field of the Invention

5           This invention relates to an image processing system and an image processing method.

### 2. Description of the Related Art

          An image processing system used for positioning of a robot arm, decision on width of sheet material or inspection of a liquid level inside a vessel is constructed so that, as basic  
10   processing, a measured object (hereinafter referred as workpiece) is picked up by a trigger from the outside and various measurements are made on a static image inside a window set.

          For example, in the case of measuring a workpiece  
15   transferred by a conveyor, when displacement occurs in a static image inside a window by vibration of a width direction of the conveyor, variations occur in image processing measured values of an edge position.

          Fig. 8 is a diagram conceptually describing this problem.  
20   Displacement of the workpiece occurs in a measurement direction at the time of performing an image pickup and when it is assumed that displacement of the workpiece  $w$  inside a window  $1$  occurs in the range of a distance  $L$  in a measurement direction shown by an arrow, variations occur in image processing measured values  
25   of an edge position.

In general, the user side has to cope with such a problem and , the problem of the variations in the measured values described above is solved by inputting plural triggers from the outside and picking up images every each trigger and  
5 statistically processing the outputs by an external device such as a personal computer and averaging the outputs.

However, a solution method of the above conventional technology is performed in the user side, and it is required that plural triggers should be inputted from the outside.  
10 Further, an external device for performing statistical processing is required.

#### Summary of the Invention

Therefore, an object of the invention is to provide an  
15 image processing system and an image processing method capable of solving the problem described above without entrusting a user.

In order to accomplish the object above, the following means are adopted. According to the invention, there is provided  
20 an image processing system comprising:

a camera for picking up a workpiece; and

an image processing apparatus for capturing image pickup data of the workpiece picked up by the camera and performing image processing, the image processing apparatus including a  
25 trigger receiving section for receiving a trigger from an outside,

a trigger generation section for generating a predetermined number of internal triggers at predetermined intervals when the trigger receiving section receives the trigger from the outside, an image processing section for performing image processing with respect to each the image pickup data picked up by the camera by the trigger from the outside and the internal triggers, and a statistical processing section for performing statistical processing of each image processing result data from the image processing section.

That is, according to the invention, in the case of receiving an external trigger performed in a conventional technology, in addition to starting an image pickup, after receiving this external trigger, a predetermined number of internal triggers are generated at predetermined intervals.

By each the internal trigger, the image pickup is performed and also measured values obtained from each image pickup data are statistically processed by the statistical processing section included in the image processing apparatus.

Therefore, the need for a user to change setting of a factory device so as to supply plural external triggers to the image processing system separately can be eliminated and also, the need to prepare an external device for performing statistical processing of image data captured plural times can be eliminated.

### Brief Description of the Drawings

Fig. 1 is a block diagram of an image processing system of an embodiment according to the invention;

Fig. 2 is a diagram conceptually describing variations  
5 in a window associated with position displacement of the workpiece;

Fig. 3 is a diagram conceptually describing variations in tape as one example of the workpiece to which the invention can be applied preferably;

10 Fig. 4 is a diagram describing application to a measured object in which plural workpieces which are one example of the workpiece to which the invention can be applied preferably are held in, for example, a box;

Fig. 5 is a flowchart describing a processing procedure  
15 of the case that the invention is applied to the workpiece transferred by a conveyor typically;

Fig. 6 is a flowchart which is a modified example of the flowchart illustrated in Fig. 5;

Fig. 7 is a flowchart describing a processing procedure  
20 of the case that the invention is applied to plural workpieces held in a box typically; and

Fig. 8 is a diagram describing a related-art problem associated with position displacement of the workpiece.

## Detailed Description of the Invention

A preferred embodiment of the invention will be described below in detail with reference to the accompanying drawings.

Fig. 1 is a diagram showing the entire outline of an image processing system according to the invention. In Fig. 1, an image processing system 10 includes a camera 12 placed toward a workpiece w transferred by, for example, a conveyor 11, and an image processing apparatus 13 connected to the camera 12. In a manner similar to the related-art case, the image processing apparatus 13 has an image processing section 14 for performing image processing of image pickup data and further optionally may have a display section 15 for displaying the result.

The image processing apparatus 13 has a trigger receiving section 17 and a trigger generation section 18 including a timer. When a trigger from the outside (that is, external trigger) is inputted to the trigger receiving section 17, for example, in synchronization with this trigger, the timer of the trigger generation section 18 operates and a predetermined number of internal triggers are generated at predetermined intervals. Image pickup is performed according to each the trigger. The number of generations of this internal trigger is preferably configured so that a user can freely set an arbitrary number of times, two or more times.

The image processing apparatus 13 includes a statistical processing section 19 in the inside and statistical processing

of image pickup data captured is performed in the inside of the image processing apparatus 13. As shown in Fig. 2, the maximum value, the minimum value, the average value, etc. of variations in the workpiece w are calculated and the results  
5 are outputted to the display section 15 and/or the outside.

An image displayed in the display section 15 may be an image based on image data picked up according to an external trigger, or maybe an image based on image data picked up according to the last trigger of plural internal triggers, or may be an  
10 image based on the maximum value or the minimum value described above.

An interval of triggers generated by the internal trigger generation section 18 may be configured so that a user can select this interval from some preset interval time, or an interval  
15 setting section 20 in which a user can arbitrarily set or change may be provided. Incidentally, accurate statistical processing result can be obtained by setting interval time so as not to synchronize with a varying period of an edge position of the workpiece.

20 In the case of performing statistical processing by the statistical processing section 19 of the image processing apparatus 13, it is preferable to decide that data deviating from a predetermined range in measured values calculated during measurement is an abnormal value and set an upper limit value  
25 and a lower limit value of data so that the abnormal value can

be eliminated from data of the statistical processing. As a result of this, variations in measured values occurring by causes other than a displacement of the workpiece  $w$  can be prevented.

As shown in Fig. 3, the invention can effectively be applied to band-shaped or line-shaped workpiece  $w$  such as cable or tape traveling the front of the camera 12 at a constant speed. With respect to such a workpiece  $w$ , for example, after receiving an external trigger in synchronization with a travel start, namely an inspection start of the workpiece  $w$ , image data is captured by triggers generated in the inside of the image processing apparatus 13 and thereby the maximum value, the minimum value, the average value, etc. of an edge width can be obtained as measured values for the whole of workpiece  $w$ .

As shown in Fig. 4, the invention can effectively be applied to plural workpieces  $w$ , for example, one dozen of workpieces  $w$  held in a box 21. With respect to the case that the plural workpieces  $w$  are held in the box 21 thus, it is configured so as to move the camera 12 as shown by arrows or rotate a mounting table (not shown) of the box 21. When each the workpiece  $w$  reaches a position opposite to the camera 12, an image is picked up by internal triggers and statistical processing is performed in the inside of the image processing apparatus 13. Therefore, the maximum value, the minimum value, the average value, etc. of the workpieces  $w$  can be obtained in a box unit rather than measured values every each the workpiece  $w$ .

Fig. 5 is a flowchart showing one example of a processing procedure performed by the image processing system 10 with respect to the workpiece w transferred by the conveyor 11 (see Fig. 1).

5        In Fig. 5, when a trigger is inputted to the trigger receiving section 17 from the outside in a manner similar to the related-art case, while an operation of an interval timer of the trigger generation section 18 is started in step S1, an internal trigger is generated in step S2 and an image pickup  
10    is performed (step S3).

Image pickup data is captured by the image processing apparatus 13 in the next step S4 and image processing is performed and thereafter, an inspection of the workpiece w, that is, an inspection as to whether or not the workpiece w is, for example,  
15    within specifications is made in step S5. This process of steps S2 to S5 is performed a predetermined set number of times. When it is determined that a preset number of times is reached in step S6, the flowchart proceeds to step S7 and the timer of the trigger generation section 18 is stopped and reset. In  
20    the next step S8, statistical processing of this predetermined number of measured values such as an edge position is performed by the statistical processing section 19. In step S9, an image indicating, for example, the maximum value is displayed on the display section 15 and/or is outputted to the outside.

25        When it is determined that a predetermined number of image



pickups are not performed in step S6 described above, the flowchart proceeds to step S10 and it is determined whether or not predetermined interval time which is time taken from one image capture to the next image capture has elapsed. When  
5 this interval time has elapsed, the flowchart proceeds to step S2 and a trigger is generated by the trigger generation section 18 and in the next step S3, an image pickup of the workpiece w is performed.

As described above, image pickup data is captured by the  
10 image processing apparatus 13 in the next step S4 and image processing is performed. Then, for example, an inspection of the workpiece w, that is, an inspection as to whether or not the workpiece w is, for example, within specifications is made in step S5 and this process of steps S2 to S5 is performed a  
15 predetermined set number of times.

Fig. 6 illustrates a modified example of the flowchart illustrated in Fig. 5. This modified example is constructed so that when a trigger is inputted from the outside, an internal trigger is immediately generated in step S20 and a first image  
20 pickup is performed (step S21) and capture (step S22) and inspection (step S23) of this first image are performed. Then, the flowchart proceeds to step S27 and an operation of an interval timer, which is used for measuring predetermined interval time taken to the next image capture since one processing was  
25 completed, is started. Here, each of steps S20 to S26 shown

in Fig. 6 substantially corresponds to each of steps S2 to S9 of Fig. 5.

Fig. 7 is a flowchart showing one example of a processing procedure of the case that the invention is applied to plural workpieces w held in a box 21 described with reference to Fig. 5. Incidentally, this example is premised on a system picking up plural workpieces w while moving a camera 12.

First, in step S30, a camera 12 is positioned in a position of first workpiece w and in the next step S31, an image pickup is performed by a trigger from the outside. Also, a timer of a trigger generation section 18 starts an operation by this trigger from the outside. Image pickup data is captured by an image processing apparatus 13 in the next step S32 and image processing is performed and thereafter an inspection of the workpiece w is made. Next, in step S33, the camera 12 is positioned in a position of second workpiece w. When predetermined interval time has elapsed and the trigger generation section 18 generates an internal trigger (step S34), image pickup data of this second workpiece w is captured by the image processing apparatus 13 in the next step S35 and image processing is performed and thereafter an inspection of the workpiece w is made. This process of steps S33 to S35 is repeatedly performed by the number of workpieces w held in the box 21. When it is determined that an inspection of the last workpiece w is completed in step S36, the flowchart proceeds

to step S37 and statistical processing of measured values of  
all the workpieces w in the box 21 is performed by a statistical  
processing section 19. As a result of that, for example, the  
maximum value of the workpieces w in the box 21 is displayed  
5 on a display section 15 and/or is outputted to the outside.

Incidentally, also in this flowchart of Fig. 1, it may  
be constructed so that first image pickup and inspection are  
performed immediately based on an external trigger and an  
internal timer is started after this first processing is  
10 completed in a manner similar to the case of Fig. 6.